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PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:	BRADY et al.	Examiner:	Ngo, C.
Serial No.:	09/694,452	Group Art Unit:	2124
Filed:	October 23, 2000	Docket No.	**BLD920000056US1** (IBMN.002US01)
Title:	FASTER DISCRETE COSINE TRANSFORMS USING SCALED TERMS		

CERTIFICATE UNDER 37 CFR 1.8: The undersigned hereby certifies that this correspondence and the papers, as described hereinabove, are being deposited in the United States Postal Service, as first class mail, in an envelope addressed to: Board of Patent Appeals and Interferences, United States Patent and Trademark Office, P.O. Box 1450, Alexandria, VA 22313-1450, on May 31, 2005.

By: David W. Lynch

APPEAL BRIEF

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Sir:

This is an Appeal Brief submitted pursuant to 37 C.F.R. § 41.37 for the above-referenced patent application. Please charge Deposit Account No. 50-0563 (**BLD920000056US1**) in the amount of $500.00 for this brief in support of appeal as indicated in 37 C.F.R. § 41.20(b)(2). If necessary, authority is given to charge/credit deposit account 50-0996 (IBMN.002US01) any additional fees/overages in support of this filing.

I. Real Party in Interest

The real party in interest is International Business Machines Corporation, having a place of business at New Orchard Road, Armonk, New York 10504. This application is assigned to International Business Machines Corporation.

II. Related Appeals and Interferences

Appellants are unaware of any related appeals, interferences or judicial proceedings.

III. Status of Claims

Claims 1-49 are rejected. Claims 1-49 are presented for appeal and may be found in the attached Appendix of Appealed Claims in their present form.

IV. Status of Amendments

No amendments to the claims were made subsequent to the final rejection of Appellants' application.

V. Summary of Invention

Faster discrete cosine transforms that use scaled terms are disclosed. Prior to application of a transform, equations are arranged into collections (Equation 1, page 18, line 4). Each collection is scaled by dividing each of the discrete cosine transform constants in the collection by one of the discrete cosine transform constants from the collection (Equation 2, page 18, line 13). Each of the scaled discrete cosine transform constants are then represented with approximated sums of powers-of-2 (Fig. 7, page 19, lines 16-18). A series of predetermined sums and shifts is performed on the data Fig. 8, page 20, lines 12-14).

In dependent claim 1, discrete cosine transform equations are arranged into collections (Equation 1, page 18, line 4), wherein at least one collection includes at least two discrete transform equations, and wherein the at least two discrete transform equations includes at least two discrete cosine transform constants (e.g., page 18, line 4, C1, C3, etc.). The discrete cosine transform equations in a collection are scaled by dividing each of the discrete cosine transform constants in the collection by one discrete cosine transform constant from the collection (Equation 2, page 18, line 13). Each of the scaled discrete

cosine transform constants is represented with sums of powers-of-2 (Fig. 7, page 19, lines 16-18), wherein the sums of powers-of-2 are calculated to approximate the scaled discrete cosine transform constants.

In dependent claim 12, a discrete cosine transformer (1010 in Fig. 10, page 21, lines 8-9) applies a discrete cosine transform to decorrelate data into discrete cosine transform equations. The discrete cosine transform equations are arranged into collections, wherein at least one collection includes at least two discrete transform equations (Equation 1, page 18, line 4), and wherein the at least two discrete transform equations includes at least two discrete cosine transform constants (e.g., page 18, line 4, C1, C3, etc.). The discrete cosine transform equations in a collection are scaled by dividing each of the discrete cosine transform constants in the collection by one discrete cosine transform constant from the collection (Equation 2, page 18, line 13). Each of the scaled discrete cosine transform constants is represented with sums of powers-of-2 (Fig. 7, page 19, lines 16-18), wherein the sums of powers-of-2 is calculated to approximate the scaled discrete cosine transform constants.

In dependent claim 25, a printer includes a memory (930 in Fig. 9, page 20, lines 17-18) for storing data, a processor (940 in Fig. 9, page 20, lines 18-19) for processing the data to provide a compressed print stream output and a printhead driving circuit (950 in Fig. 9, page 20, line 20) for controlling a printhead to generate a printout of the data. The processor (940 in Fig. 9, page 20, lines 18-19) applies a discrete cosine transform to decorrelate data into transform coefficients using discrete cosine equations. The discrete cosine transform equations are arranged into collections (Equation 1, page 18, line 4), wherein at least one collection includes at least two discrete transform equations, and wherein the at least two

discrete transform equations includes at least two discrete cosine transform constants (e.g., page 18, line 4, C1, C3, etc.). The discrete cosine transform equations in a collection are scaled by dividing each of the discrete cosine transform constants in the collection by one discrete cosine transform constant from the collection (Equation 2, page 18, line 13). Each of the scaled discrete cosine transform constants is represented with sums of powers-of-2 (Fig. 7, page 19, lines 16-18), wherein the sums of powers-of-2 is calculated to approximate the scaled discrete cosine transform constants.

In dependent claim 36, an article of manufacture includes a program storage medium (990 in Fig. 9, page 20, lines 122-23) readable by a computer (940 in Fig. 9, page 20, lines 18-19), the medium (990 in Fig. 9, page 20, lines 122-23) tangibly embodying one or more programs of instructions executable by the computer to use equations created by a method for generating faster discrete cosine transforms. The discrete cosine transform equations are arranged into collections (Equation 1, page 18, line 4), wherein at least one collection includes at least two discrete transform equations, and wherein the at least two discrete transform equations includes at least two discrete cosine transform constants (e.g., page 18, line 4, C1, C3, etc.). The discrete cosine transform equations in a collection are scaled by dividing each of the discrete cosine transform constants in the collection by one discrete cosine transform constant from the collection (Equation 2, page 18, line 13). Each of the scaled discrete cosine transform constants is represented with sums of powers-of-2 (Fig. 7, page 19, lines 16-18), wherein the sums of powers-of-2 is calculated to approximate the scaled discrete cosine transform constants.

In dependent claim 47, a data analysis system includes a memory (930 in Fig. 9, page 20, lines 17-18) for storing discrete cosine transform equations formed by arranging discrete

cosine transform equations into collections (Equation 1, page 18, line 4), wherein at least one collection includes at least two discrete transform equations, and wherein the at least two discrete transform equations includes at least two discrete cosine transform constants (e.g., page 18, line 4, C1, C3, etc.). The discrete cosine transform equations in a collection are scaled by dividing each of the discrete cosine transform constants in the collection by one discrete cosine transform constant from the collection (Equation 2, page 18, line 13). Each of the scaled discrete cosine transform constants is represented with sums of powers-of-2 (Fig. 7, page 19, lines 16-18), wherein the sums of powers-of-2 is calculated to approximate the scaled discrete cosine transform constants. A transformer (1010 in Fig. 10, page 21, lines 8-9) applies the transform equations to perform a discrete cosine transform to decorrelate data into discrete cosine transform coefficients.

VI. Grounds of Rejection

A. Claims 1-49 were rejected under § 103(a) over Babkin (U.S. Patent No. 5,642,438) in view of Mattela et al. (U.S. Patent No. 5,781,239).

B. Claims 1-49 were rejected under § 103(a) over Babkin (U.S. Patent No. 5,642,438) in view of Dierke (U.S. Patent No. 5,854,757).

VII. Argument

I. INDEPENDNET CLAIMS 1, 12, 25, 36 AND 47 ARE PATENTABLE OVER BABKIN (U.S. PATENT NO. 5,642,438) IN VIEW OF MATTELA ET AL. (U.S. PATENT NO. 5,781,239).

A. Babkin And Mattela et al. Fail To Disclose, Teach Or Suggest the Limitations of Independent Claims 1, 12, 25, 36 And 47.

1. Babkin And Mattela et al. Fail To Disclose, Teach, Or Suggest Arranging Discrete Cosine Transform Equations Into Collections, Wherein At Least One Collection Includes At Least Two Discrete Transform Equations, And Wherein The At Least Two Discrete Transform Equations Includes At Least Two Discrete Cosine Transform Constants.

Babkin does not suggest arranging discrete cosine transform equations into collections, wherein at least one collection includes at least two discrete transform equations, and wherein the at least two discrete transform equations includes at least two discrete cosine transform constants. The Office Action indicated that the first two rows in the transform matrix Q constitute a collection that includes at least two discrete transform equations, wherein the at least two discrete transform equations includes at least two discrete cosine transform constants.

However, the first two rows of the transform matrix Q are not treated as a collection. Rather, the first two rows are merely the coefficients for $\widetilde{F}(0)$ and $\widetilde{F}(2)$. As further evidence that the first two rows of the transform matrix Q are not treated as a collection, the first row includes all "1's" because $\alpha / 2$ has been factored out and is represented by $\widetilde{F}(0)$ being equal to $2F(0)/\alpha$. Similarly, the second row includes all "1's", either positive or negative, because $\delta / 2$ has been factored out and is represented by $\widetilde{F}(2)$ being equal to $2F(0)/\delta$. The remaining rows have similarly been factored individually.

Mattela et al. is merely cited as teaching approximating numbers as a sum of powers of 2. However, Appellant respectfully submits that Mattela et al. rather discloses representing numbers as truncated "exact" binary representations. Thus, Mattela et al. fails to suggest approximating numbers as a sum of powers of 2. Nevertheless, Mattela et al. is completely silent regarding arranging discrete cosine transform equations into collections, wherein at least one collection includes at least two discrete transform equations, and wherein the at least two discrete transform equations includes at least two discrete cosine transform constants. Thus, Mattela et al. fails to remedy the deficiencies of Babkin.

Accordingly, Babkin and Mattela et al. do not teach, disclose or suggest arranging discrete cosine transform equations into collections, wherein at least one collection includes at least two discrete transform equations, and wherein the at least two discrete transform equations includes at least two discrete cosine transform constants. Therefore, Appellant respectfully submits that the independent claims are patentable over Babkin and Mattela et al.

2. Babkin And Mattela et al. Fail To Disclose, Teach, Or Suggest Scaling The Discrete Cosine Transform Equations In A Collection By Dividing Each Of The Discrete Cosine Transform Constants In The Collection By One Discrete Cosine Transform Constant From The Collection

Babkin and Mattela et al. do not suggest scaling the discrete cosine transform equations in a collection by dividing each of the discrete cosine transform constants in the collection by one discrete cosine transform constant from the collection. As indicated above, according to Babkin, the discrete cosine transform equations are not arranged in a collection, and further a collection, comprising at least two equations, is not scaled by dividing each of the discrete cosine transform constants in the collection by one discrete cosine transform

constant from the collection. Rather, Babkin merely scales each equation individually as demonstrated above.

As indicated above, Mattela et al. is merely cited as teaching approximating numbers as a sum of powers of 2. However, Appellant respectfully submits that Mattela et al. rather discloses representing numbers as truncated "exact" binary representations. Thus, Mattela et al. fails to suggest approximating numbers as a sum of powers of 2. Nevertheless, Mattela et al. is completely silent regarding scaling the discrete cosine transform equations in a collection by dividing each of the discrete cosine transform constants in the collection by one discrete cosine transform constant from the collection. Thus, Mattela et al. fails to remedy the deficiencies of Babkin.

Accordingly, Babkin and Mattela et al. do not teach, disclose or suggest scaling the discrete cosine transform equations in a collection by dividing each of the discrete cosine transform constants in the collection by one discrete cosine transform constant from the collection. Therefore, Appellant respectfully submits that the independent claims are patentable over Babkin and Mattela et al.

3. Babkin And Mattela et al. Fail To Disclose, Teach, Or Suggest Scaling The Discrete Cosine Transform Equations In A Collection By Dividing Each Of The Discrete Cosine Transform Constants In The Collection By One Discrete Cosine Transform Constant From The Collection

Babkin and Mattela et al. do not suggest representing each of the scaled discrete cosine transform constants with sums of powers-of-2, wherein the sums of powers-of-2 are calculated to approximate the scaled discrete cosine transform constants. As indicated above, the discrete cosine transform equations are not arranged in a collection, and further a collection, comprising at least two equations, is not scaled by dividing each of the discrete

cosine transform constants in the collection by one discrete cosine transform constant from the collection. As such, Babkin cannot represent each of "the scaled discrete cosine transform constants" with sums of powers-of-2.

Moreover, as indicated above, Mattela et al. is merely cited as teaching approximating numbers as a sum of powers of 2. However, Appellant respectfully submits that Mattela et al. rather discloses representing numbers as truncated "exact" binary representations. Thus, Mattela et al. fails to suggest approximating numbers as a sum of powers of 2. Nevertheless, Mattela et al. is completely silent regarding scaling the discrete cosine transform equations in a collection by dividing each of the discrete cosine transform constants in the collection by one discrete cosine transform constant from the collection. Thus, Mattela et al. fails to remedy the deficiencies of Babkin.

Accordingly, Babkin and Mattela et al. do not teach, disclose or suggest representing each of "the scaled discrete cosine transform constants" with sums of powers-of-2, wherein the sums of powers-of-2 are "calculated to approximate" the scaled discrete cosine transform constants. Therefore, Appellant respectfully submits that the independent claims are patentable over Babkin and Mattela et al.

B. Babkin And Mattela et al. Fail To Disclose, Teach Or Suggest the Limitations of Dependent Claims 4-7, 17-20, 28-31, 39-42 And 49.

1. Babkin And Mattela Et Al. Fail To Disclose, Teach Or Suggest Choosing The Discrete Cosine Transform Constant For Scaling The Discrete Cosine Transform Equations In The At Least One Collection According To A Predetermined Cost Function.

Babkin does not suggest choosing the discrete cosine transform constant for scaling the discrete cosine transform equations in the at least one collection according to a predetermined cost function. Rather, according to Babkin, each row is scaled individually. Babkin teaches that the first two rows are merely the coefficients for $\widetilde{F}(0)$ and $\widetilde{F}(2)$ and that the first row includes all "1's" because $\alpha / 2$ has been factored out and is represented by $\widetilde{F}(0)$ being equal to $2F(0) / \alpha$. Similarly, the second row includes all "1's", either positive or negative, because $\delta / 2$ has been factored out and is represented by $\widetilde{F}(2)$ being equal to $2F(0) / \delta$. Thus, the remaining rows have similarly been factored individually and are not scaled according to a cost function.

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Accordingly, Babkin and Mattela et al. do not teach, disclose or suggest choosing the discrete cosine transform constant for scaling the discrete cosine transform equations in the at

least one collection according to a predetermined cost function. Therefore, Appellant respectfully submits that the dependent claims 4-7, 17-20, 28-31, 39-42 and 49 are patentable over Babkin and Mattela et al.

C. Babkin And Mattela et al. Fail To Disclose, Teach Or Suggest the Limitations of Dependent Claims 2, 3, 8-11, 13-16, 21-23, 26-27, 32-35, 37-38, 43-46 and 48.

1. Claims 2, 3, 8-11, 13-16, 21-23, 26-27, 32-35, 37-38, 43-46 and 48 are patentable over Babkin And Mattela et al. for the same reasons given above.

Claims 2, 3, 8-11, 13-16, 21-23, 26-27, 32-35, 37-38, 43-46 and 48 include the same limitations of the independent claims discussed above. For the same reasons, Claims 2, 3, 8-11, 13-16, 21-23, 26-27, 32-35, 37-38, 43-46 and 48 are patentable over Babkin And Mattela et al.

II. INDEPENDNET CLAIMS 1, 12, 25, 36 AND 47 ARE PATENTABLE OVER BABKIN (U.S. PATENT NO. 5,642,438) IN VIEW OF DIERKE (U.S. PATENT NO. 5,854,757).

A. Babkin And Dierke Fail To Disclose, Teach Or Suggest the Limitations of Independent Claims 1, 12, 25, 36 And 47.

1. Babkin And Dierke Fail To Disclose, Teach, Or Suggest Arranging Discrete Cosine Transform Equations Into Collections, Wherein At Least One Collection Includes At Least Two Discrete Transform Equations, And Wherein The At Least Two Discrete Transform Equations Includes At Least Two Discrete Cosine Transform Constants.

Babkin does not suggest arranging discrete cosine transform equations into collections, wherein at least one collection includes at least two discrete transform equations,

and wherein the at least two discrete transform equations includes at least two discrete cosine transform constants. The Office Action indicated that the first two rows in the transform matrix Q constitute a collection that includes at least two discrete transform equations, wherein the at least two discrete transform equations includes at least two discrete cosine transform constants.

However, the first two rows of the transform matrix Q are not treated as a collection. Rather, the first two rows are merely the coefficients for $\widetilde{F}(0)$ and $\widetilde{F}(2)$. As further evidence that the first two rows of the transform matrix Q are not treated as a collection, the first row includes all "1's" because $\alpha / 2$ has been factored out and is represented by $\widetilde{F}(0)$ being equal to $2F(0)/\alpha$. Similarly, the second row includes all "1's", either positive or negative, because $\delta / 2$ has been factored out and is represented by $\widetilde{F}(2)$ being equal to $2F(0)/\delta$. The remaining rows have similarly been factored individually.

Dierke is merely cited as teaching approximating numbers as a sum of powers of 2. However, Appellant respectfully submits that Dierke rather discloses partitioning a matrix N so that many of the same patterns and redundancies of the original transform matrix still exist, including the matching of columns necessary for a "butterfly" operation. The coefficients in left half (columns 0 through 3) of the normalized matrix N are identical to those in the right half (columns 7 through 4), except for the sign. Furthermore, the signs of the even rows (rows 0, 2, 4 and 6) of the normalized matrix N are the same on both sides, while the signs of the odd rows (rows 1, 3, 5, and 7) on the right side are the opposite of those on the left side. According to Dierke, this allows the normalized matrix N to be split vertically right down the middle and horizontally along the even and odd-numbered rows. Thus, Dierke merely discloses computing EVEN and ODD sums that include a divisor that

may be a power of 2. However, the coefficients themselves are not represented as an approximation based upon a sum of powers of 2. Thus, Dierke fails to suggest approximating numbers as a sum of powers of 2.

Nevertheless, Dierke is completely silent regarding arranging discrete cosine transform equations into collections, wherein at least one collection includes at least two discrete transform equations, and wherein the at least two discrete transform equations includes at least two discrete cosine transform constants. Thus, Dierke fails to remedy the deficiencies of Babkin.

Accordingly, Babkin and Dierke do not teach, disclose or suggest arranging discrete cosine transform equations into collections, wherein at least one collection includes at least two discrete transform equations, and wherein the at least two discrete transform equations includes at least two discrete cosine transform constants. Therefore, Appellant respectfully submits that the independent claims are patentable over Babkin and Dierke

2. Babkin And Dierke Fail To Disclose, Teach, Or Suggest Scaling The Discrete Cosine Transform Equations In A Collection By Dividing Each Of The Discrete Cosine Transform Constants In The Collection By One Discrete Cosine Transform Constant From The Collection

Babkin and Dierke do not suggest scaling the discrete cosine transform equations in a collection by dividing each of the discrete cosine transform constants in the collection by one discrete cosine transform constant from the collection. As indicated above, according to Babkin, the discrete cosine transform equations are not arranged in a collection, and further a collection, comprising at least two equations, is not scaled by dividing each of the discrete cosine transform constants in the collection by one discrete cosine transform constant from

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As indicated above, Dierke is merely cited as teaching approximating numbers as a sum of powers of 2. However, Appellant respectfully submits that Dierke rather discloses partitioning a matrix N so that many of the same patterns and redundancies of the original transform matrix still exist, including the matching of columns necessary for a "butterfly" operation. The coefficients in left half (columns 0 through 3) of the normalized matrix N are identical to those in the right half (columns 7 through 4), except for the sign. Furthermore, the signs of the even rows (rows 0, 2, 4 and 6) of the normalized matrix N are the same on both sides, while the signs of the odd rows (rows 1, 3, 5, and 7) on the right side are the opposite of those on the left side. According to Dierke, this allows the normalized matrix N to be split vertically right down the middle and horizontally along the even and odd-numbered rows. Thus, Dierke merely discloses computing EVEN and ODD sums that include a divisor that may be a power of 2. However, the coefficients themselves are not represented as an approximation based upon a sum of powers of 2. Thus, Dierke fails to suggest approximating numbers as a sum of powers of 2.

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B. Babkin And Dierke Fail To Disclose, Teach Or Suggest the Limitations of Dependent Claims 4-7, 17-20, 28-31, 39-42 And 49.

1. Babkin And Dierke Fail To Disclose, Teach Or Suggest Choosing The Discrete Cosine Transform Constant For Scaling The Discrete Cosine Transform Equations In The At Least One Collection According To A Predetermined Cost Function.

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Accordingly, Babkin and Dierke do not teach, disclose or suggest choosing the discrete cosine transform constant for scaling the discrete cosine transform equations in the at least one collection according to a predetermined cost function. Therefore, Appellant respectfully submits that the dependent claims 4-7, 17-20, 28-31, 39-42 and 49 are patentable over Babkin and Dierke

C. Babkin And Dierke Fail To Disclose, Teach Or Suggest the Limitations of Dependent Claims 2, 3, 8-11, 13-16, 21-23, 26-27, 32-35, 37-38, 43-46 and 48.

1. Claims 2, 3, 8-11, 13-16, 21-23, 26-27, 32-35, 37-38, 43-46 and 48 are patentable over Babkin And Dierke for the same reasons given above.

Claims 2, 3, 8-11, 13-16, 21-23, 26-27, 32-35, 37-38, 43-46 and 48 include the same limitations of the independent claims discussed above. For the same reasons, Claims 2, 3, 8-11, 13-16, 21-23, 26-27, 32-35, 37-38, 43-46 and 48 are patentable over Babkin And Dierke

VIII. Conclusion

In view of the above, Appellants submit that the rejections are improper, the claimed invention is patentable, and that the rejections and objections of claims 1-49 should be reversed. Appellants respectfully request reversal of the rejections as applied to the appealed claims and allowance of the entire application.

Authority to charge the assignee's deposit account was provided on the first page of this brief.

Respectfully submitted,

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APPENDIX OF APPEALED CLAIMS FOR APPLICATION NO. 09/694,452

1. (Previously Presented) A method for generating faster discrete cosine transforms, comprising:

arranging discrete cosine transform equations into collections, wherein at least one collection includes at least two discrete transform equations, and wherein the at least two discrete transform equations includes at least two discrete cosine transform constants;

scaling the discrete cosine transform equations in a collection by dividing each of the discrete cosine transform constants in the collection by one discrete cosine transform constant from the collection; and

representing each of the scaled discrete cosine transform constants with sums of powers-of-2, wherein the sums of powers-of-2 are calculated to approximate the scaled discrete cosine transform constants.

2. (Original) The method of claim 1 further comprising separating an image into at least one block and transforming the block into transformed data by performing matrix multiplication on the discrete cosine transform equations based upon binary arithmetic using the estimated scaled discrete cosine transform constants and performing linear shifts and additions.

3. (Original) The method of claim 1 wherein the scaling the discrete cosine transform equations in the at least one collection by dividing each of the discrete cosine transform constants in the at least one collection by one of the discrete cosine transform constants from the at least one collection saves multiplications.

4. (Original) The method of claim 1 wherein the discrete cosine transform constant chosen for scaling the discrete cosine transform equations in the at least one collection is selected according to a predetermined cost function.

5. (Original) The method of claim 4 wherein the cost function minimizes a number of add operations.

6. (Original) The method of claim 4 wherein the cost function minimizes a worst case number of add operations.

7. (Original) The method of claim 4 wherein the cost function minimizes an error per constant resulting from the approximations.

8. (Original) The method of claim 2 wherein the transforming the block into transformed data further comprises using at least one set of one dimensional discrete cosine transform equations.

9. (Original) The method of claim 8 wherein the discrete cosine transform constants are obtained by splitting the discrete cosine transform constants into even and odd terms by obtaining sums and differences of input samples.

10. (Original) The method of claim 2 wherein the block is an N_1xN_2 block.

11. (Original) The method of claim 10 wherein $N_1 = N_2 = 8$.

12. (Previously Presented) A data compression system, the data compression system comprising a discrete cosine transformer for applying a discrete cosine transform to decorrelate data into discrete cosine transform equations, the discrete cosine transform equations having been formed by arranging discrete cosine transform equations into collections, wherein at least one collection includes at least two discrete transform equations, and wherein the at least two discrete transform equations includes at least two discrete cosine transform constants, scaling the discrete cosine transform equations in a collection by dividing each of the discrete cosine transform constants in the collection by one discrete cosine transform constant from the collection and representing each of the scaled discrete cosine transform constants with sums of powers-of-2, wherein the sums of powers-of-2 is calculated to approximate the scaled discrete cosine transform constants.

13. (Original) The data compression system of claim 12 further comprising a quantizer for quantizing the transformed data into quantized data to reduce the number of bits needed to represent the transform coefficients.

14. (Original) The data compression system of claim 12 wherein the discrete cosine transformer further separates an image into at least one block and transforms the block into transformed data using the discrete cosine transform equations based upon binary arithmetic using the estimated scaled discrete cosine transform constants and performing linear shifts and additions.

15. (Original) The data compression system of claim 12 wherein the transformer executes equations that save multiplication operations, the equations having been formed by scaling the discrete cosine transform equations in the at least one collection by dividing each of the discrete cosine transform constants in the at least one collection by one of the discrete cosine transform constants from the at least one collection.

16. (Original) The data compression system of claim 15 further comprising an entropy encoder for further compressing the quantized coefficients losslessly.

17. (Original) The data compression system of claim 12 wherein the discrete cosine transform constant used for scaling the discrete cosine transform equations in the at least one collection is selected according to a predetermined cost function.

18. (Original) The data compression system of claim 17 wherein the cost function minimizes a number of add operations.

19. (Original) The data compression system of claim 17 wherein the cost function minimizes a worst case number of add operations.

20. (Original) The data compression system of claim 17 wherein the cost function minimizes an error per constant resulting from the approximations.

21. (Original) The data compression system of claim 12 wherein discrete cosine transformer uses at least one set of one dimensional discrete cosine transform equations.

22. (Original) The data compression system of claim 22 wherein the equations split the discrete cosine transform coefficients into even and odd terms by obtaining sums and differences of input samples.

23. (Original) The data compression system of claim 14 wherein the block is an $N_1 x N_2$ block.

24. (Original) The data compression system of claim 23 wherein $N_1 = N_2 = 8$.

25. (Previously Presented) A printer, comprising:

a memory for storing data;

a processor for processing the data to provide a compressed print stream output; and

a printhead driving circuit for controlling a printhead to generate a printout of the data;

wherein the processor applies a discrete cosine transform to decorrelate data into transform coefficients using discrete cosine equations, the discrete cosine transform equations having been formed by arranging discrete cosine transform equations into collections, wherein at least one collection includes at least two discrete transform equations, and wherein the at least two discrete transform equations includes at least two discrete cosine transform constants, scaling the discrete cosine transform equations in a collection by dividing each of the discrete cosine transform constants in the collection by one discrete cosine transform constant from the collection and representing each of the scaled discrete cosine transform constants with sums of powers-of-2, wherein the sums of powers-of-2 is calculated to approximate the scaled discrete cosine transform constants.

26. (Original) The printer of claim 25 wherein the processor further separates an image into at least one block and transforms the block into transformed data by performing matrix multiplication on the discrete cosine transform equations based upon binary arithmetic using the estimated scaled discrete cosine transform constants and performing linear shifts and additions.

27. (Original) The printer of claim 25 wherein the processor executes equations that save multiplication operations, the equations having been formed by scaling the discrete cosine transform equations in a collection by dividing each of the discrete cosine transform constants in the at least one collection by one of the discrete cosine transform constants from the at least one collection.

28. (Original) The printer of claim 25 wherein the discrete cosine transform constant used in scaling the discrete cosine transform equations in the at least one collection is selected according to a predetermined cost function.

29. (Original) The printer of claim 28 wherein the cost function minimizes a number of add operations.

30. (Original) The printer of claim 28 wherein the cost function minimizes a worst case number of add operations.

31. (Original) The printer of claim 28 wherein the cost function minimizes an error per constant resulting from the approximations.

32. (Original) The printer of claim 25 wherein processor uses at least one set of one dimensional discrete cosine transform equations.

33. (Original) The printer of claim 32 wherein the processor splits the discrete cosine transform coefficients into even and odd terms by obtaining sums and differences of input samples.

34. (Original) The printer of claim 26 wherein the block is an $N_1 x N_2$ block.

35. (Original) The printer of claim 34 wherein $N_1 = N_2 = 8$.

36. (Previously Presented) An article of manufacture comprising a program storage medium readable by a computer, the medium tangibly embodying one or more programs of instructions executable by the computer to use equations created by a method for generating faster discrete cosine transforms, the method comprising:

arranging discrete cosine transform equations into collections, wherein at least one collection includes at least two discrete transform equations, and wherein the at least two discrete transform equations includes at least two discrete cosine transform constants;

scaling the discrete cosine transform equations in a collection by dividing each of the discrete cosine transform constants in the collection by one discrete cosine transform constant from the collection; and

representing each of the scaled discrete cosine transform constants with sums of powers-of-2, wherein the sums of powers-of-2 are calculated to approximate the scaled discrete cosine transform constants.

37. (Original) The article of manufacture of claim 36 further comprising separating an image into at least one block and transforming the block into transformed data by using discrete cosine transform equations based upon binary arithmetic using the estimated scaled discrete cosine transform constants and performing linear shifts and additions.

38. (Original) The article of manufacture of claim 36 wherein the scaling the discrete cosine transform equations in the at least one collection by dividing each of the discrete cosine transform constants in the at least one collection by one of the discrete cosine transform constants from the at least one collection saves multiplications.

39. (Original) The article of manufacture of claim 36 wherein the discrete cosine transform constant chosen for scaling the discrete cosine transform equations in the at least one collection is selected according to a predetermined cost function.

40. (Original) The article of manufacture of claim 39 wherein the cost function minimizes a number of add operations.

41. (Original) The article of manufacture of claim 39 wherein the cost function minimizes a worst case number of add operations.

42. (Original) The article of manufacture of claim 39 wherein the cost function minimizes an error per constant resulting from the approximations.

43. (Original) The article of manufacture of claim 36 wherein the transforming the block into transformed data further comprises using at least one set of one dimensional discrete cosine transform equations.

44. (Original) The article of manufacture of claim 43 wherein the discrete cosine transform constants are obtained by splitting the discrete cosine transform constants into even and odd terms by obtaining sums and differences of input samples.

45. (Original) The article of manufacture of claim 37 wherein the block is an N_1xN_2 block.

46. (Original) The article of manufacture of claim 45 wherein $N_1 = N_2 = 8$.

47. (Previously Presented) A data analysis system, comprising; a memory for storing discrete cosine transform equations having been formed by arranging discrete cosine transform equations into collections, wherein at least one collection includes at least two discrete transform equations, and wherein the at least two discrete transform equations includes at least two discrete cosine transform constants, scaling the discrete cosine transform equations in a collection by dividing each of the discrete cosine transform constants in the collection by one discrete cosine transform constant from the collection and representing each of the scaled discrete cosine transform constants with sums of powers-of-2, wherein the sums of powers-of-2 is calculated to approximate the scaled discrete cosine transform constants; and

a transformer for applying the transform equations to perform a discrete cosine transform to decorrelate data into discrete cosine transform coefficients.

48. (Original) The data analysis system of claim 47 wherein the transformer further separates an image into at least one block and transforms the block into transformed data by using the discrete cosine transform equations based upon binary arithmetic using the estimated scaled discrete cosine transform constants and performing linear shifts and additions.

49. (Original) The data analysis system of claim 47 wherein the discrete cosine transform constant used for scaling the discrete cosine transform equations in the at least one collection is selected according to a predetermined cost function.

APPENDIX OF EVIDENCE FOR APPLICATION NO. 09/694,452

Appellants are unaware of any evidence submitted in this application pursuant to 37 C.F.R. §§ 1.130, 1.131, and 1.132.

APPENDIX OF RELATED PROCEEDINGS FOR APPLICATION NO. 09/694,452

As stated in Section II above, Appellants are unaware of any related appeals, interferences or judicial proceedings.